FABRIC-REINFORCED BELT FOR CONVEYING FOOD

CROSS-REFERENCE TO RELATED APPLICATION

The present application claims the benefit of U.S. Provisional Application No. 60/448,037, which was filed February 18, 2003, and is incorporated herein by reference, in its entirety.

BACKGROUND OF THE INVENTION

The present inventions relate to composite sheets and, more particularly, to fabric-reinforced belts for conveying food that is being processed.

It is conventional to convey food that is being processed on conveyor belts that include polymeric materials, such as elastomeric polymeric materials. In some cases, the conveyor belts consist of woven fabrics that are coated or laminated with the polymeric material. In other cases, the conveyor belts consist of solid sheets of the polymeric material that are not reinforced with fabrics.

For a conveyor belt that consists of woven fabric that is coated or laminated with polymeric material, an advantage is that the fabric carcass substantially prevents the belt from stretching. On the other hand, a disadvantage is that the exposed fabric at the cut side edges of the belt can absorb fluids that can harbor hazardous microorganisms. Accordingly, it is common to seal cut side edges of fabric-reinforced belting material that is used to convey food that is being processed, so that the cut side edges do not absorb fluids. The material used for the edge sealing must be thick and abrasion resistant enough so that it does not wear through for a reasonable time. Such edge sealing materials are known to become dislodged from their belts, which is disadvantageous because the dislodged pieces can contaminate the food being processed.

Advantageously, edge sealing is not required for a conveyor belt consisting of a solid sheet of the polymeric material that is not reinforced with fabric, because the cut side edges of the belt do not absorb liquids. However, and disadvantageously, belts of this type can stretch because they are not reinforced with fabric.

Accordingly, there is a need in the art for an improved material that can be cut to an appropriate width and then be used as a conveyor belt of a food-processing machine,

or the like, without having to seal the cut side edge or edges, and without the belt stretching too much.

BRIEF SUMMARY OF THE INVENTION

One aspect of the present invention is the provision of an improved composite sheet that can be cut to an appropriate width and then be used as a conveyor belt of a food-processing machine, or the like, preferably without having to seal the cut edge or edges of the belt, and preferably without the belt stretching too much.

In accordance with one aspect of the present invention, a composite sheet includes a fabric that is at least partially embedded in a polymeric sheet. Advantageously, the fabric restricts stretching of the composite sheet. As another advantage, the fabric includes longitudinally extending warp yarns and laterally extending weft yarns, with there being one or more pairs of substantially spaced apart, yet adjacent, warp yarns. For each pair, the two warp yarns are spaced apart from one another buy a sufficient distance so that the composite sheet can be longitudinally slit or cut at a position between and distant from the two warp yarns, to provide one or more long sections of the composite sheet that can be used as conveyor belts. Preferably the warp yarns are not exposed at the cut side edges or upper and lower surfaces of the sections of the composite sheet. As a result, the sections of the composite sheet can be advantageously used to convey food in a food-processing machine, or the like, without having to seal the cut side edge(s).

In accordance with one aspect of the present invention, weft yarns are exposed at the cut side edges of the sections of the composite sheet. However, and advantageously, the weft yarns are preferably polyester monofilament yarns and the composite sheet is preferably substantially absent of unfilled cavities. Therefore, and advantageously, the cut side edges preferably do not absorb fluids / do not have to be sealed.

In accordance with one aspect of the present invention, the warp yarns are confined to one or more longitudinally extending warp-including areas of the composite sheet, and any longitudinal cutting of the composite sheet is preferably done within one or more longitudinally extending warpless areas of the composite sheet. The warpless areas preferably do not include any of the warp yarns of the composite sheet. It is preferred for multiple of the warpless and warp-including areas of the composite sheet to

be arranged in a laterally extending series, so that multiple locations for possible longitudinal cutting are provided. The warpless areas preferably each have a lateral width that is sufficiently large so that long sections of the composite material can be cut/slit lengthwise without cutting into, and thereby exposing, any of the warp yarns.

In one version of the present invention, each warp-including area includes only one warp yarn, and in other versions each warp-including area includes two, three or more warp yarns. It is preferred for the spacing between adjacent warp yarns that are located in the same warp-including area to be less than the lateral width of the warpless areas.

In accordance with one aspect of the present invention, all or some of the weft yarns, or at least portions of some or all of the weft yarns, melt together with the polymeric sheet. Although it is preferred for all of the embodiments of the present invention for the cut edges of the composite sheet to be substantially impermeable to fluid, such impermeability may be enhanced with the melting of the weft yarns and the polymeric sheet to one another. That is, in accordance with one aspect of the present invention, the cut side edges are substantially impermeable to fluid and/or there are no weft yarns apparent at the cut side edges and/or the cut side edges are substantially homogeneous.

The foregoing and some of the other aspects of the present invention are described in the following.

BRIEF DESCRIPTION OF THE DRAWINGS

Having thus described the invention in general terms, reference will now be made to the accompanying drawings, which are not necessarily drawn to scale, and wherein:

Figure 1 is a schematic, side elevational view of a prior art conveyor system, and Figure 1 is illustrative of features of an exemplary embodiment of the present invention;

Figure 2 is a partial, top plan view of a composite sheet that can be cut into sections that are made endless and used in place of the conveyor belt of Figure 1, with phantom lines schematically illustrating longitudinally extending warpless and warp-including areas of the composite sheet, and the original longitudinally extending side

edges of the composite sheet having already been trimmed away, in accordance with the exemplary embodiment of the present invention;

Figure 3 is a partial, top plan view of the composite sheet of Figure 2, with part of a polymeric sheet of the composite sheet removed to expose an embedded fabric of the composite sheet, with phantom lines schematically illustrating the warpless and warp-including areas;

Figure 4 is an elevational view of a portion of a longitudinally extending side edge of the composite sheet of Figure 2;

Figure 5 is an elevational view of a portion of a laterally extending end edge of the composite sheet of Figure 2;

Figure 6 is an isolated, schematic, substantially enlarged view of a portion of the fabric of Figure 3;

Figure 7 diagrammatically illustrates methods and apparatus for forming the composite sheet of Figure 2, and for forming endless sections of the composite sheet (e.g., endless conveyor belts), in accordance with the exemplary embodiment of the present invention; and

Figure 8 schematically illustrates a step of longitudinally cutting/separating sections of the composite sheet, in accordance with the exemplary embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The present inventions now will be described more fully hereinafter with reference to the accompanying drawings, in which some, but not all embodiments of the inventions are shown. Indeed, these inventions may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will satisfy applicable legal requirements. Like numbers refer to like elements throughout.

Figure 1 is a schematic, side elevational view of portions of a prior art conveyor system **20**, and Figure 1 is illustrative of some of the features of an exemplary embodiment of the present invention. The conveyor system **20** includes an endless conveyor belt **22** that extends around a plurality of rollers **24** that carry the conveyor belt

and are rotatably mounted to a frame **26**. The conveyor belt **22** is endless by virtue of opposite ends of the belt being joined together at a joint, which is preferably in the form of a splice. As illustrated in Figure 1, the conveyor belt **22** is driven by virtue of one of the rollers **24** being driven. One or more of the rollers **24** are driven, such as via a drive belt **28**, by a motor **30** that is mounted to the frame **26**. A variety of other types of mechanisms for driving the conveyor belt **22** are also within the scope of the present invention. As illustrated in Figure 1, the upper run of the belt is carrying / transporting food **32**, or the like. The conveyor system **20** is preferably part of a food-processing machine that is for processing the food **32**.

Referring to the top plan view of Figure 2, one aspect of the present invention is an improved composite sheet **34** that can advantageously be cut longitudinally into sections **36** (Figures 7 and 8) that can be made into endless belts **38** (Figure 7). The endless belts **38** can be used in place of the conveyor belt **22** of Figure 1, such as for carrying / transporting food **32** that is being processed, or the like. It is preferred for any of such longitudinal cutting of the composite sheet **34** to be within longitudinally extending warpless areas **40** (e.g., areas without warp yarns), rather than being within longitudinally extending warp-including areas **42** (e.g., areas that include warp yarns). The areas **40**, **42**, which are arranged in a laterally extending series, are schematically illustrated by phantom lines in Figure 2. As should be understood by those of ordinary skill in the art, phantom lines are imaginary lines formed by alternating two short dashes and a longer dash.

The composite sheet **34** is shown broken in the middle in Figure 2 to disclose that it can be a variety of different lengths, and it can also be a variety of different widths, with the length preferably being many times greater than the width. More specifically, it is preferred for the composite sheet **34** to be manufactured in lengths of many feet, such as, but not limited to, a hundred feet or more, or a thousand feet or more. In accordance with the exemplary embodiment of the present invention, the width of the composite sheet **35**, which is the distance between side edges **52** of the composite sheet / polymeric sheet **46**, can be about seven feet or a little less, although a variety of other widths are also acceptable.

As best understood with reference to Figure 3, the composite sheet **34** includes, and most preferably it consists essentially of, a fabric **44** that is preferably at least substantially embedded in a polymeric sheet **46**. The fabric **44** can be characterized as defining the warpless and warp-including areas **40, 42**. Figure 3 is a partial, top plan view of the composite sheet **34**, with an upper portion of the polymeric sheet **46** removed to expose a portion of the fabric **44**. Phantom lines also schematically and partially illustrate the warpless and warp-including areas **40, 42** in Figures 3 and 5.

Referring to Figure 3, the fabric **44** preferably includes warp yarns **48** extending in a longitudinal direction and weft yarns **50** extending in a lateral direction that is at least about perpendicular to the longitudinal direction. Throughout the figures, only a representative few of the yarns **48, 50** are respectively identified by their reference numerals in an effort to clarify the drawings. In accordance with the exemplary embodiment of the present invention, the warpless areas **40** preferably do not include any of the warp yarns **48**, and each of the warp-including **42** areas preferably includes one or more of the warp yarns **48**. In accordance with the exemplary embodiment of the present invention, all of the weft yarns **50** extend into each of the warpless and warp-including areas **40, 42**, and preferably all of the weft yarns extend completely across each of the warpless and warp-including areas, especially after original, longitudinally extending side edges of the composite sheet **34** are trimmed, as will be discussed in greater detail below.

In accordance with the exemplary embodiment of the present invention, and as will be discussed in greater detail below, the fabric **44** advantageously provides sufficient strength in the warp direction to prevent undesired longitudinal stretching of the composite sheet **34**, the fabric advantageously provides adequate space between the warp-including areas **42** for optimal slitting/cutting to width, and the fabric allows enough space between the weft yarns **50** to allow the polymeric material of the polymeric sheet **46** to originally flow around each of the weft yarns **50**.

Referring respectively to Figures 2-5, the polymeric sheet **46** preferably includes: longitudinally extending side edges **52** that are laterally spaced apart from one another; laterally extending end edges **54** that are longitudinally spaced apart from one another; and outer, broad, upper and lower surfaces **56, 58** that each extend longitudinally and laterally between, and are contiguous with, the edges **52, 54**. In accordance with the

exemplary embodiment of the present invention, all of the warp and weft yarns **48**, **50** of the fabric **44** are positioned between the upper and lower surfaces **56**, **58**, and none of the warp and weft yarns of the fabric are exposed at either of the upper and lower surfaces. For example, Figure 2 is illustrative of none of the yarns **56**, **58** of the fabric **44** being exposed at either of the upper and lower surfaces **56**, **58** because Figure 2 is illustrative of both top and bottom plan views of the composite sheet **34**. As illustrated in Figure 4, preferably none of the warp yarns **48** are exposed at either of the side edges **52**, whereas the weft yarns **50** preferably are exposed at the side edges **52**. In contrast, and as illustrated in Figure 5, the warp yarns **48** preferably are exposed at the end edges **54**.

In accordance with the exemplary embodiment of the present invention, the weft yarns **50** are not necessarily exposed at the original side edges of the composite sheet **34**, but the original side edges (not shown) are preferably trimmed away to provide the illustrated side edges **52** at which the weft yarns are exposed. That is, and in accordance with the exemplary embodiment of the present invention, the original side edges of the composite sheet **34** may be ragged, such that they are cut away, which results in the side edges **52**. Accordingly, a wide variety of constructions of the original side edges of the composite sheet **34** are within the scope of the present invention, because those original side edges are preferably cut away. Likewise, the illustrated end edges **54** are preferably formed by trimming. Alternatively, and if desired, special care can be taken to form the original edges in a manner such that they need not be cut away.

Referring to Figures 4 and 5, the polymeric sheet **46** /composite sheet **34** preferably defines a thickness **T** that is defined between, and substantially perpendicular to, the upper and lower surfaces **56**, **58**. In accordance with the exemplary embodiment of the present invention, the thickness **T** is less than about 0.4 inches, more preferably the thickness **T** is about 0.04 inches to about 0.4 inches, and most preferably the thickness **T** is about 0.1 inches.

Referring primarily to Figure 5, each of the warp-including areas **42** preferably has a laterally extending width **W1** and includes all of the thickness of the polymeric sheet **46** that is within the width **W1**. In accordance with the exemplary embodiment of the present invention, each width **W1** is at least about the diameter of a single one of the warp yarns **48**, more preferably each width **W1** is about the diameter of a single one of

the warp yarns **48** to about one foot, and most preferably each width **W1** is about 0.5 inches.

As also illustrated in Figure 5, each of the interior warpless areas **40** preferably has a laterally extending width **W2** and includes all of the thickness **T** of the polymeric sheet **46** that is within the width **W2**, and each of the outer warpless areas **40** preferably has a laterally extending width **W3** and includes all of the thickness **T** of the polymeric sheet **46** that is within the width **W3**. In accordance with the exemplary embodiment of the present invention, each width **W2** is greater than or at least about 0.3 inches, more preferably each width **W2** is greater than or at least about 0.3 inches to about 1.5 inches, and most preferably each width **W2** is about 0.6 inches. In accordance with the exemplary embodiment of the present invention, each width **W3** is greater than or at least about 0.15 inches, more preferably each width **W3** is greater than or at least about 0.15 inches to about 0.75 inches, and most preferably each width **W3** is about 0.3 inches.

In accordance with an alternative embodiment of the present invention, the widths **W3** are the same as, or about the same as, the widths **W2**. Indeed, alternative embodiments of the present invention can include variations upon the outer warpless areas **40**, laterally extending widths **W3** and longitudinally extending side edges **52** because, for example, in some cases longitudinal slitting (e.g., discussed below with reference to Figure 8) is not necessary proximate the longitudinally extending side edges of the composite sheet **34**. For example, in accordance with alternative embodiments of the present invention, wide composite sheets may include only one or very few warpless areas **40** in predetermined position(s) that are located solely where longitudinal slitting is desired. The only desired longitudinal slitting may be distant from the longitudinally extending side edges, such as by being along the centerline of the composite sheet.

Figure 6 is an isolated, schematic, substantially enlarged view of a portion of the fabric **44**, in accordance with the exemplary embodiment of the present invention. The lateral width **W2** (Figures 2, 3 and 5) of each interior warpless area **40** (Figures 2, 3 and 5) preferably corresponds to a separation distance **D1** (Figure 6) between substantially spaced apart, yet adjacent, warp yarns **48** that respectively belong to adjacent warp-including areas **42** (Figures 2, 3 and 5). Accordingly, each separation distance **D1** is greater than or at least about 0.3 inches, more preferably each separation distance **D1** is

greater than or at least about 0.3 inches to about 1.5 inches, and most preferably each separation distance **D1** is about 0.6 inches. In accordance with the exemplary embodiment of the present invention, for pairs of adjacent warp yarns **48** that are within the same warp-including area **42**, the separation distance **D2** (Figure 6) between the warp yarns of each pair is substantially less than the separation distance **D1** between the substantially spaced apart, yet adjacent, warp yarns that respectively belong to adjacent warp-including areas **42**.

As best understood with reference to Figures 3 and 6, it is preferred for the warp and weft yarns **48**, **50** to form a relatively open weave in the warp-including areas **42**. Preferably the weave inhibits unwanted slipping and displacement of the yarns **48**, **50**, and most preferably the weave is the leno weave. The leno weave is a conventional weave that should be understood by those of ordinary skill in the art. Those of ordinary skill in the art will understand that in an exemplary leno weaving process, the warp yarns are arranged in pairs, and the filling (i.e., weft yarns) are shot straight across the fabric as in a plain weave, except that the warp threads are alternately twisted in a right-hand and left-hand direction, crossing before each pick is inserted. The leno weave gives firmness and strength to an open-weave cloth, which reduces unwanted slipping and displacement of the yarns. That is, and in accordance with the exemplary embodiment of the present invention, the warp yarns **48** are preferably woven around the weft yarns **50** in a leno configuration so that in each of the warp-including areas **42**, there are four pairs of closely adjacent warp yarns, with each pair about equally spaced from the adjacent pair. In accordance with the exemplary embodiment of the present invention, the leno weave provides substantial interlocking of the warp and weft yarns **48**, **50** to one another, and this interlocking results in the fabric **44** being sufficiently stable during the process of substantially embedding the fabric in the polymeric sheet **46**.

In accordance with the exemplary embodiment of the present invention, the warp yarns **48** can be any type of yarn that provides adequate tensile properties to preferably prevent undesirable stretching of the composite sheet **34**, and preferably they are multifilament polyester yarns. More specifically, the warp yarns **48** can be about 500 denier yarns to about 2000 denier yarns, and they are preferably 1000 denier multifilament polyester yarns that are arranged so that each warp-including area **42**

includes eight of the warp yarns. In accordance with the exemplary embodiment of the present invention, the alternating arrangement of the warp-including and warpless areas **42**, **40** is repeated across the entire width of the fabric, resulting in an averaged count of about 7.2 warp yarns **48** per inch of width of the fabric **44**.

In accordance with the exemplary embodiment of the present invention, a meaningful number of, more preferably a majority of, and most preferably all of the weft yarns **50** are a type of yarn that does not tend to absorb fluid (e.g., solid polyester monofilament yarns). More specifically, the weft yarns **50** are preferably about 560 denier polyester monofilament yarns that are uniformly spaced far enough apart so that the polymeric sheet substantially encapsulates the weft yarns. Preferably there are about 10 weft yarns **50** per inch of length of the fabric **44**. In accordance with the exemplary embodiment of the present invention, the fabric **44** is available as Style No. 930202 from Milliken & Company of Spartanburg, South Carolina; however, the fabric **44** can be any other type of fabric that imparts the desired effect to the composite sheet **34**.

Figure 7 diagrammatically illustrates methods and apparatus for forming the composite sheet **34**, for cutting sections **36** from the composite sheet, and for making endless belts **38** from the sections, in accordance with the exemplary embodiment of the present invention. The fabric **44** is preferably unwound from a roll **60** and transported by one or more transport mechanisms **62** arranged along the travel path of the fabric **44** and/or the composite sheet **34**. The fabric **44** is transported through a coater or between coaters **64**. Any type of suitable coater(s) known in the art of wide web or textile coating may be used. In the coater or between the coaters **64**, the fabric **44** is preferably at least substantially embedded in the polymeric sheet **46** to form the composite sheet **34**. More specifically, the coaters **64** may utilize sheet extrusion, or extrusion calendaring, on both sides of the fabric **44** to at least substantially embed the fabric in the polymeric sheet **46**. Alternatively, the coaters **64** may respectively laminate premade polymeric sheets to the sides of the fabric using sufficient heat to soften the sheets so that the sheets flow around the yarns **48**, **50** of the fabric and the sheets adhere to one another at the edges of the fabric and through the spaces between the yarns of the fabric. In accordance with the exemplary embodiment of the present invention, the polymeric sheet **46** is an elastomeric material, and most preferably it is polyurethane, or the like.

As part of the coating process, or just downstream from the coaters **64**, the composite sheet **34** may be passed between calendar cylinders, or the like, to impart a surface texture on one or both of the upper and lower surfaces **56**, **58** of the composite sheet, and/or the composite sheet may be passed between chilled rollers for cooling purposes. The composite sheet **34** is then preferably formed into a roll **66**. Thereafter, and in some cases at a different facility, the composite sheet is unwound from the roll **66** by one or more transport mechanisms **68** positioned along the travel path of the composite sheet. At a cutting mechanism **70**, sections **36** are cut from the composite sheet **34**. In accordance with the exemplary embodiment of the present invention, the sections **36** are cut both laterally and longitudinally.

As best understood with reference to Figure 8, the sections **36** are preferably longitudinally cut from the composite sheet **34** with a slitter/knife **72**, preferably along the centerline of one of the warpless areas **40**, so that the warp yarns **48** are not exposed at the cut side edges **52** of the resulting sections, as shown in Figure 4. That is, when the composite sheet **34** is slit/cut to width, the cut side edges **52** of the resulting sections **36** of the composite sheet preferably consist solely of the polymeric sheet **46** surrounding exposed terminuses of the weft yarns **50**, as shown in Figure 4.

Longitudinal relative movement between the knife **72** and the composite sheet **34** facilitates the longitudinal cutting with the knife. This longitudinal relative movement is schematically illustrated in Figure 8 by virtue the knife **72** being illustrated by both solid and broken lines. The broken-line illustration of the knife **72** is illustrative of the before-cutting position and the solid-line illustration of the knife **72** is illustrative of the after-cutting position. The composite sheet **34** / sections **36** are shown broken in the middle in Figure 8 to disclose that they can be a variety of different lengths, and they can also be a variety of different widths, with the lengths preferably being many times greater than the widths. More specifically, it is preferred for the longitudinal cutting with the knife **72** to be continuous, with the cut extending for at least several feet, and in many situations the continuous cut will extend for ten feet to fifteen feet, twenty feet, thirty feet or more, or even greater lengths, such as, but not limited to, a hundred feet or more.

In addition or as an alternative to the slitter **72** being a knife with a sharp cutting edge, the slitter **72** can be an ultrasonic cutting device or another type of cutting device

which heats the cut side edges **52** in an advantageous manner. For example, in some situations such heating, or heating by way of other means, can cause the portions of the weft yarns **50** which are proximate the cut side edges **52** and the portions of the polymeric sheet **46** which are proximate the cut side edges to melt together in an advantageous manner which is discussed in greater detail below

Referring back to Figure 7, each of the sections **36** is preferably joined end-to-end at a splicing mechanism **74** to form an endless belt **38**. For each section **36**, it is made into an endless belt **38** by bringing the two ends of the section together and melting the polymeric sheet **46** at the ends to form a thermoplastic splice. By making the splice in this manner, the warp yarns **48** proximate the splice are advantageously not exposed so that they cannot absorb liquid. That is, in accordance with the exemplary embodiment of the present invention, all of the warp yarns **48** of each endless belt **38** are fully encapsulated in the polymeric sheet **46** of the endless belt **38**. As a result, and advantageously, the endless belts **38** can be used in place of the conveyor belt **22** of Figure 1 for transporting food **32** during processing of the food, preferably without ever having to apply a sealant material to the side edges **52** of the endless belts **38**. In accordance with an alternative embodiment of the present invention, some sealant may be applied to the side edges **52** and/or other surfaces of the belts **38**.

In accordance with the exemplary embodiment of the present invention, it is preferred, for example, for none of the warp yarns **48** of the endless belts **38** to be exposed, and for each of the warpless and warp-including areas **40, 42** of an endless belt **38** to contain all of the weft yarns **50** of the endless belt. Although these and other configurations are preferred for the exemplary embodiment of the present invention, alternative embodiments of the present invention include variations of the preferred configurations of the exemplary embodiment. For example, in accordance with one embodiment of the present invention, it is acceptable for one or more of the warp yarns **48** of an endless belt **38** to be exposed at an exterior surface of the endless belt and/or for one or more of the weft yarns **50** of the endless belt not to extend into one or more of the warpless and warp-including areas **40, 42** of the endless belt.

In accordance with an alternative embodiment of the present invention, the fabric **44** is woven by means other than the leno weave. As one example, it is believed that

another type of weave could be used in the warp-including areas **42**, such as, but not limited to, a plain weave. In such situations, it may be beneficial to have the coater(s) **64** positioned immediately downstream from and closely adjacent to the weaving loom that is producing the fabric, so that the polymeric sheet **46** is applied to the fabric as the fabric exits the loom, without forming the fabric into a roll **60** between the steps of manufacturing the fabric and forming the composite sheet. In this alternative embodiment, it is believed that the polymeric sheet **46** could sufficiently restrict relative movement between the yarns of the fabric such that it would not be necessary to use the leno weave.

Indeed, in accordance one embodiment of the present invention, each of the warp-including areas **42** includes only one warp yarn so that each of the warp-including areas would have a width of about the diameter of the warp yarns; and in this embodiment it would be preferred for each of the warp-including areas to include all of the weft yarns, and for the warp and weft yarns to be respectively interlaced with one another such that the fabric is plainly woven or woven in any other suitable manner. In other versions of this embodiment, each of the warp-including sections could include two, three or more warp yarns, and preferably: for each pair of adjacent warp yarns that are within the same warp-including area, the spacing between the warp yarns of the pair is less than the spacing between adjacent warp-including areas; each of the warp-including areas includes all of the weft yarns; and the warp and weft yarns are respectively interlaced with one another such that the fabric is plainly woven or woven in any other suitable manner.

Although it is preferred, in accordance with the exemplary embodiment and some of the other embodiments of the present invention, for the yarns of the fabric to be respectively interlaced with one another such that the fabric is woven, other types of fabrics can be used in place of the woven fabrics.

Other alternative embodiments can be respectively identical to each of the exemplary and other embodiments described herein, except for variations noted and variations that will be apparent to those of ordinary skill in the art in view of this disclosure. In accordance with each of these alternative embodiments, the weft yarns **50** of the fabric **44** can be the same type of material as the polymeric sheet **46** (e.g., a

polyester elastomeric or a polyester urethane elastomeric), or the materials of the fabric **44** and the polymeric sheet **46** are otherwise selected, so that the weft yarns **50**, or at least some or portions of the weft yarns **50**, melt into the polymeric sheet **46** when the polymeric sheet is applied to the fabric **44**, or at some other time, and the melted weft yarns or melted portions of the weft yarns become part of the polymeric sheet, such that the composite sheet **34** does not include any weft yarns or reduced numbers and/or portions of weft yarns. For example, the coater(s) **64** (Figure 7) could be operated so that during the above-described coating process, the temperature of the polymeric sheet **46** is above each of its melting point and the melting point of the weft yarns **50**. Although it is preferred for all of the embodiments of the present invention for the cut side edges **52** to be substantially impermeable to fluid, such impermeability may be enhanced by the melting of the weft yarns **50** into the polymeric sheet **46**. That is, in accordance with the present alternative embodiments, the cut side edges **52** are substantially impermeable to fluid and/or there are no weft yarns **50** apparent at the cut side edges **52** and/or the cut side edges **52** are substantially homogeneous. In accordance with another embodiment of the present invention, any appearance of the weft yarns **50** at the cut side edges **52** is minimized by having the weft yarns **50** be the same color as the polymeric sheet **46**.

In one example, a hot iron (not shown) is rubbed along / proximate the cut side edges **52** of the composite sheet **34** in an effort to eliminate any bubbles in the polymeric sheet **46** which might have been exposed by the cutting of the edges. In addition, the hot iron, or other heating equipment, could be used, such as when the weft yarns **50** of the fabric **44** are the same type of material as the polymeric sheet **46** (or where these materials are otherwise selected to provide the desired end result), to cause the portions of the weft yarns which are proximate the cut side edges **52** and the portions of the polymeric sheet which are proximate the cut side edges to melt together such that the cut side edges **52** are substantially impermeable to fluid and/or there are no weft yarns **50** apparent at the cut side edges **52** and/or the cut side edges **52** are substantially homogeneous. As another example, any of the above-discussed melting together can also be achieved by passing the composite sheet **34** through heated nip rolls or by way of any other means for obtaining the desired result.

Many modifications and other embodiments of the inventions set forth herein will come to mind to one skilled in the art to which these inventions pertain having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. Therefore, it is to be understood that the inventions are not to be limited to the specific embodiments disclosed and that modifications and other embodiments are intended to be included within the scope of the appended claims. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.